BEFORE THE
PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA
DOCKET NO. 2018-3-E

In the Matter of Annual Review of Base Rates for Fuel Costs for Duke Energy Carolinas, LLC	))))	**DIRECT TESTIMONY OF** **JOSEPH A. MILLER, JR. FOR** **DUKE ENERGY CAROLINAS, LLC**

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Joseph A. Miller, Jr. and my business address is 526 South Church Street, Charlotte, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am Vice President of Central Services for Duke Energy Business Services, LLC ("DEBS"). DEBS is a service company subsidiary of Duke Energy Corporation ("Duke Energy"), which provides services to Duke Energy and its subsidiaries, including Duke Energy Carolinas, LLC ("DEC" or the "Company") and Duke Energy Progress, LLC ("DEP").

Q. WHAT ARE YOUR CURRENT DUTIES AS VICE PRESIDENT OF CENTRAL SERVICES?

A. In this role, I am responsible for providing engineering, environmental compliance planning, generation and regulatory strategy, technical services, and maintenance services, for Duke Energy's fleet of fossil, hydroelectric, and solar (collectively, "fossil/hydro/solar") facilities.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND.

A. I graduated from Purdue University with a Bachelor of Science degree in Mechanical Engineering. I also completed twelve post graduate level courses in Business Administration at Indiana State University. My career began with Duke Energy (d/b/a Public Service of Indiana) in 1991 as a staff engineer at Duke Energy Indiana's Cayuga Steam Station. Since that time, I have held various roles of increasing responsibility in the generation engineering, maintenance, and operations areas, including the role of station manager, first at

Duke Energy Kentucky's East Bend Steam Station, followed by Duke Energy Ohio's Zimmer Steam Station. I was named General Manager of Analytical and Investment Engineering in 2010, and became General Manager of Strategic Engineering in 2012 following the merger between Duke Energy and Progress Energy, Inc. I became the Vice President of Central Services in 2014.

Q. HAVE YOU TESTIFIED BEFORE THIS COMMISSION IN ANY PRIOR PROCEEDINGS?

A. Yes. I testified before the Public Service Commission of South Carolina in DEC's 2016 and 2017 annual fuel proceedings in Docket Nos. 2016-3-E and 2017-3-E, as well as in DEP's 2016 and 2017 annual fuel proceedings in Docket Nos. 2016-1-E and 2017-1-E, respectively.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. The purpose of my testimony is to (1) describe DEC's fossil/hydro/solar generation portfolio and changes made since the 2017 fuel cost recovery proceeding, as well as those expected in the near term, (2) discuss the performance of DEC's fossil/hydro/solar facilities during the review period of June 1, 2017 through May 31, 2018 (the "review period"), (3) provide information on significant fossil/hydro/solar outages that occurred during the review period, and (4) provide information concerning environmental compliance efforts.

Q. PLEASE DESCRIBE DEC'S FOSSIL/HYDRO/SOLAR GENERATION PORTFOLIO.

A. The Company's fossil/hydro/solar generation portfolio consists of approximately 14,966 megawatts ("MWs") of generating capacity, made up as follows:

Coal-fired -	6,764 MWs
Steam Natural Gas -	170 MWs
Hydro -	3,245 MWs
Combustion Turbines -	2,665 MWs
Combined Cycle -	2,083 MWs
Solar -	39 MWs

The coal-fired assets consist of four generating stations and a total of 13 units. These units are equipped with emissions control equipment, including selective catalytic or selective non-catalytic reduction ("SCR" or "SNCR") equipment for removing nitrogen oxides ("NO_x"), and flue gas desulfurization ("FGD" or "scrubber") equipment for removing sulfur dioxide ("SO_2"). In addition, all 13 coal-fired units are equipped with low NO_x burners. The steam natural gas unit – W.S. Lee Station ("Lee") Unit 3 – is considered to be a peaking unit.

The Company has a total of 31 simple cycle combustion turbine ("CT") units, of which 29 are considered the larger group providing approximately 2,581 MWs of capacity. These 29 units are located at Lincoln, Mill Creek, and Rockingham Stations, and are equipped with water injection systems that reduce NO_x and/or have low NO_x burner equipment in use. The Lee CT facility includes two units with a total capacity of 84 MWs equipped with fast-start ability in support of DEC's Oconee Nuclear Station. The 2,083 MWs, shown earlier as "combined cycle" ("CC"), represent the Buck CC, Dan River CC, and W.S. Lee CC facilities. These facilities are equipped with technology for

emissions control including SCRs, low NO_x burners, and carbon monoxide/volatile organic compounds catalysts. The Company's hydro fleet includes two pumped storage facilities with four units each that provide a total capacity of 2,140 MWs, along with conventional hydro assets consisting of 74 units providing approximately 1,105 MWs of capacity. The 39 MWs of solar capacity are made up of 18 roof top solar sites providing 4 MWs of relative summer dependable capacity, the Mocksville solar site providing 7 MWs of relative summer dependable capacity and the Monroe solar site providing 28 MWs of relative summer dependable capacity.

Q. WHAT CAPACITY CHANGES HAVE OCCURRED WITHIN THE FLEET SINCE THE LAST FUEL CASE?

A. DEC added W.S. Lee CC in April 2018, which added 753 MWs of capacity. DEC retired Rocky Creek hydro units 1-8 and Great Falls hydro units 3, 4, 7, and 8 in May 2018. Based on unit condition and economic evaluations, the company retired these over 100 year old hydro assets.

Q. WHAT ARE DEC'S OBJECTIVES IN THE OPERATION OF ITS FOSSIL/HYDRO/SOLAR FACILITIES?

A. The primary objective of DEC's fossil/hydro/solar generation department is to provide safe, reliable, and cost-effective electricity to DEC's customers. Operations personnel and other station employees are well-trained and execute their responsibilities to the highest standards in accordance with procedures, guidelines, and a standard operating model. Like safety, environmental compliance is a "first principle" and DEC works very hard to achieve high level results.

The Company complies with all applicable environmental regulations and maintains station equipment and systems in a cost-effective manner to ensure reliability for customers. The Company also takes action in a timely manner to implement work plans and projects that enhance the safety and performance of systems, equipment, and personnel, consistent with providing low-cost power options for DEC's customers. Equipment inspection and maintenance outages are generally scheduled during the spring and fall months when customer demand is reduced due to milder temperatures. These outages are well-planned and executed to prepare the unit for reliable operation until the next planned outage in order to maximize value for customers.

Q. WHAT IS HEAT RATE?

A. Heat rate is a measure of the amount of thermal energy needed to generate a given amount of electric energy and is expressed as British thermal units ("Btu") per kilowatt-hour ("kWh"). A low heat rate indicates an efficient fleet that uses less heat energy from fuel to generate electrical energy.

Q. WHAT HAS BEEN THE HEAT RATE OF DEC'S COAL UNITS DURING THE REVIEW PERIOD?

A. Over the review period, the average heat rate for DEC's coal fleet was 9,292 Btu/kWh. Based on operating performance data for 2017 that was published in the June 2018 issue of *Power Engineering* magazine, DEC's Rogers Energy Complex ("Cliffside"), Belews Creek Steam Station ("Belews Creek") and Marshall Steam Station ("Marshall") ranked as the second, fourth, and eighth most efficient coal-fired generating stations in the nation with heat rates of 9,055 Btu/kWh, 9,167 Btu/kWh, and 9,495 Btu/kWh, respectively. These results

compare favorably to the average heat rate of 10,476 Btu/kWh for North American coal generators, also reported in the above noted magazine. For the review period, the Belews Creek units provided 36 percent of coal-fired generation for DEC, with the Marshall units providing 38 percent.

Q. HOW MUCH GENERATION DID EACH TYPE OF FOSSIL/HYDRO/SOLAR GENERATING FACILITY PROVIDE FOR THE REVIEW PERIOD AND HOW DOES DEC UTILIZE EACH TYPE OF GENERATING FACILITY TO SERVE CUSTOMERS?

A. The Company's system generation totaled 100,135,321 MW hours ("MWhs") for the review period. The fossil/hydro/solar fleet provided 39,289,740 MWhs, or approximately 39 percent of the total generation. The breakdown includes a 25 percent contribution from the coal-fired stations, approximately 11 percent from CC operations, 2 percent contribution for the CTs, 1 percent from the hydro facilities, 0.2 percent from the solar facilities, and approximately 0.1 percent from the steam natural gas facility, Lee Unit 3.

The Company's portfolio includes a diverse mix of units that, along with additional nuclear capacity, allow DEC to meet the dynamics of customer load requirements in a logical and cost-effective manner. Additionally, DEC has utilized the Joint Dispatch Agreement ("JDA"), which allows generating resources for DEC and DEP to be dispatched as a single system to enhance dispatching the lowest cost resources available. The cost and operational characteristics of each unit generally determine the type of customer load situation (e.g., base and peak load requirements) that a unit would be called upon, or dispatched, to support.

Q. HOW DID DEC COST EFFECTIVELY DISPATCH THE DIVERSE MIX OF GENERATING UNITS DURING THE REVIEW PERIOD?

A. The Company, like other utilities across the U.S., has experienced a change in the dispatch order for each type of generating facility due to favorable economics resulting from the low pricing of natural gas. Further, the addition of new CC units within the Carolinas' portfolio in recent years has provided DEC with additional natural gas resources that feature state-of-the-art technology for increased efficiency and significantly reduced emissions. These factors promote the use of natural gas and provide real benefits in cost of fuel and reduced emissions for customers.

Q. PLEASE DISCUSS THE OPERATIONAL RESULTS FOR DEC'S FOSSIL/HYDRO/SOLAR FLEET DURING THE REVIEW PERIOD.

A. The Company's generating units operated efficiently and reliably during the review period. Several key measures are used to evaluate the operational performance depending on the generator type: (1) equivalent availability factor ("EAF"), which refers to the percent of a given time period a facility was available to operate at full power, if needed (EAF is not affected by the manner in which the unit is dispatched or by the system demands; it is impacted, however, by planned and unplanned (*i.e.*, forced) outage time); (2) net capacity factor ("NCF"), which measures the generation that a facility actually produces against the amount of generation that theoretically could be produced in a given time period, based upon its maximum dependable capacity (NCF *is* affected by the dispatch of the unit to serve customer needs); (3) equivalent forced outage rate ("EFOR"), which represents the percentage of unit failure (unplanned

outage hours and equivalent unplanned derated[1] hours); a low EFOR represents fewer unplanned outage and derated hours, which equates to a higher reliability measure; and, (4) starting reliability ("SR"), which represents the percentage of successful starts.

The following chart provides operational results categorized by generator type, as well as results from the most recently published North American Electric Reliability Council ("NERC") Generating Unit Statistical Brochure ("NERC Brochure") representing the period 2012 through 2016. The NERC data reported for the coal-fired units represents an average of comparable units based on capacity rating. The data in the chart reflects DEC results compared to NERC five-year comparisons.

Generator Type	Measure	Review Period	2012-2016	Nbr of Units
		DEC Operational Results	NERC Average	
Coal-Fired Test Period	EAF	79.9%	79.5%	789
	NCF	42.3%	57.6%	
	EFOR	5.9%	8.0%	
Coal-Fired Summer Peak	EAF	95.9%	n/a	n/a
Total CC Average	EAF	89.6%	84.8%	301
	NCF	78.6%	53.0%	
	EFOR	0.66%	5.5%	
Total CT Average	EAF	85.1%	87.6%	826
	SR	99.0%	98.1%	
Hydro	EAF	80.1%	81.1%	1,120

[1] Derated hours are hours the unit operation was less than full capacity.

Q. PLEASE DISCUSS SIGNIFICANT OUTAGES OCCURRING AT DEC'S FOSSIL/HYDRO/SOLAR FACILITIES DURING THE REVIEW PERIOD.

A. In general, planned maintenance outages for all fossil and larger hydro units are scheduled for the spring and fall to maximize unit availability during periods of peak demand. Most of these units had at least one small planned outage during this review period to inspect and maintain plant equipment.

Marshall Unit 1 completed an outage in Fall 2017. The primary purpose of this outage was to replace the HP and LP turbine rotors. Belews Creek Unit 1 completed major boiler maintenance in Fall 2017, which included secondary super heat inlet and outlet header replacements. Allen Units 1-5 completed an outage in Fall 2017 for the station dry ash conversion project, which included piping reroutes and tie-in points on multiple systems. Marshall Unit 3 and Marshall Unit 4 completed outages in Spring 2018. The primary purpose of the outages was to perform boiler inspections and boiler maintenance.

The CC fleet performed planned outages at Dan River CC and Buck CC in Spring 2018. The primary purpose of the Dan River CC and Buck CC outages was to perform a borescope and heat recovery steam generator inspection.

The CT fleet performed a planned outage at Lincoln CT Unit 9 and Unit 10. The primary purpose of the outage was to upgrade the turbine controls system.

Within the hydro fleet, Cowans Ford Unit 1 had a major generator overhaul, controls upgrade, and installed a dissolved oxygen system.

Q. HOW DOES DEC ENSURE EMISSIONS REDUCTIONS FOR ENVIRONMENTAL COMPLIANCE?

A. The Company has installed pollution control equipment in order to meet various current federal, state, and local reduction requirements for NO_x and SO_2 emissions. The SCR technology that DEC currently operates on the coal-fired units uses ammonia or urea for NO_x removal. The SNCR technology employed at Allen station and Marshall Units 1, 2 and 4 injects urea into the boiler for NO_x removal. All DEC coal units have wet scrubbers installed which use crushed limestone for SO_2 removal. Cliffside 6 has a state-of-the-art SO_2 reduction system which couples a wet scrubber (e.g., limestone) and dry scrubber (e.g., quicklime). SCR equipment is also an integral part of the design of the Buck and Dan River CC Stations in which aqueous ammonia is introduced for NO_x removal.

Overall, the type and quantity of chemicals used to reduce emissions at the plants varies depending on the generation output of the unit, the chemical constituents in the fuel burned, and/or the level of emissions reduction required. The Company is managing the impacts, favorable or unfavorable, as a result of changes to the fuel mix and/or changes in coal burn due to competing fuels and utilization of non-traditional coals. Overall, the goal is to effectively comply with emissions regulations and provide the optimal total-cost solution for operation of the unit. The Company will continue to leverage new technologies and chemicals to meet both present and future state and federal emission requirements including the Mercury and Air Toxics Standards ("MATS") rule. MATS chemicals that DEC uses when required to reduce

emissions include, but may not be limited to, activated carbon, mercury oxidation chemicals, and mercury re-emission prevention chemicals. Company witness McGee provides the cost information for DEC's chemical use and forecast.

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes, it does.